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PERCHING BEHAVIOR OF *CANTHON VIRIDIS* (COLEOPTERA: SCARABAEIDAE) IN MARYLAND[1]

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Abstract.—*Canthon viridis* Beauv. is shown to perch on leaf surfaces near a food source (dung) before attempting consumption. It is hypothesized that predator pressure by staphylinids has contributed to the development of this behavior. Correlated with perching behavior in *C. viridis* is low population density, relative absence of diurnal beetle competitors, observed predation by *Staphylinus maculosus* Grav., the capability of feeding on old feces abandoned by staphylinid predators, and a long survival period without food.

Introduction

It has been known for quite a few years that numerous species of Scarabaeinae (Coleoptera: Scarabaeidae) can be found perching on vegetation above the forest floor (Ohaus 1900). Recent investigators have suggested that perching behavior may function to partition resources among competing species (Howden and Nealis 1978; Young 1978). All previous reports of this behavior, however, originate from tropical areas (Halffter and Matthews 1966; Howden and Young 1981). I report herein observations of perching by a species of Scarabaeinae in a north temperate (Maryland) forest and present a hypothesis relating to such behavior.

Observations

As part of a two-year study of the arthropods associated with dung in Maryland, pitfall traps baited with human feces were placed weekly in a 50 hectare oak-hickory forest 4 km NE of Clarksville, Howard County. On 14 May 1979, at 0900 hr, a trap on gently sloping terrain was freshly baited and then observed for one hour from a distance of three meters upslope. Five minutes after bait placement, one *Canthon viridis* Beauv. was observed flying in a zig-zag manner upslope at a height of approximately 15 cm. When the beetle was within one meter of the bait, it landed on a horizontal leaf

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surface 30 cm above the forest floor. For the next ten minutes it remained inactive, facing the bait. At the end of this period the beetle flew directly to the trap and was captured. No other scarabs were attracted to the bait during the one hour observation period. This same sequence of behaviors was also observed with single individuals of *C. viridis* in the same forest near fecal material on 12 June and 2 July 1979, and on 6 and 9 June 1980. During the two-year period of this study, no other scarabaeine species was observed perching on leaf surfaces in this forest.

Laboratory Experiments

Starvation.—During the period June–Sept. 1979, individuals of several dung beetle species were brought into the laboratory and maintained at ambient temperature (20–30°C) in 473 cc glass mason jars with a screen top and 4 cm of packed soil in the bottom. Individuals were exposed to cow or human dung for 48 hr, then removed to a fresh container and monitored daily for survival without food. Atomized water was routinely added to maintain suitable moisture conditions. Five individuals of *C. viridis* ($\bar{x}$ length = 5 mm) were processed in this manner and lived an average of 32 days (R = 27–36). Similar-sized species of *Aphodius* did not live as long under these conditions (*A. lividus,* $\bar{x}$ = 17 days, R = 11–20, n = 50; *A. rurícola,* $\bar{x}$ = 22 days, R = 12–25, n = 40).

Predation.—During the period June–Sept. 1979, individuals of *Staphylinus maculosus* Grav. ($\bar{x}$ length = 21 mm, n = 15) were brought into the laboratory and maintained under the same conditions as in the starvation experiments previously discussed. Food in this case, however, was small dung beetles placed alive in each cage every second day. On ten separate occasions, a single *C. viridis* was placed in a container with one *S. maculosus* (six different individuals) and was consumed on the average in 40 minutes (R = 15–85).

Discussion

In Maryland, *Canthon viridis* occurs uncommonly in forests at fecal material and even more rarely at carrion (pers. obs.). Usually no more than two individuals will co-occur at a specific food site. Other forest-inhabiting diurnal coprophagous scarabs are likewise quite rare, with the vast majority of the coprophagous scarab guild—such as species of *Aphodius, Ateuchus, Canthon, Copris, Geotrupes,* and *Onthophagus*—occurring at night.

Areas of the neotropics where perching in scarabaeines has been reported may contain many species displaying this behavior. At Rio Palenque, Ecuador, of 35 species of scarabaeines captured at human feces, 11 species also perched on leaf surfaces (Howden and Nealis 1978). In a feeding guild of

this size, as the authors suggest, perching behavior may indeed be an important component of foraging strategies effecting resource partitioning. In a Maryland forest, however, where only one scarabaeine species sits on leaves during the day and other diurnally-active dung scarabs are rare or absent, resource partitioning among competing species does not appear to be related to perching behavior.

Daytime competition for dung in Maryland forests appears to occur primarily among the Diptera, with many predaceous Coleoptera usually in association. Some of the predatory beetles (Staphylinidae) are common, large (>15 mm), diurnally active, and capable of consuming small and medium-sized dung beetles. These predators include *Creophilus maxillosus* (L.), *Ontholestes cingulatus* (Grav.), and *Staphylinus maculosus.* Laboratory experiments show that at least *S. maculosus* can capture *Canthon viridis* quite easily and completely consume one individual in as little as 15 minutes.

Perching behavior in *C. viridis* may be correlated most closely with parameters associated with predation. One of those correlations may be between the age (and odoriferous nature) of dung and the presence of staphylinids and scarabs. Fresh fecal material in Maryland forests is quickly utilized by Diptera if produced during the day and by scarabs if produced at night. Occasionally, dung can be found in the forest that has not been completely utilized and is a week or more in age. Diptera and staphylinids will not be present on this old dung, but *C. viridis* may occasionally occur. In one experiment during July 1979, human feces left exposed on the forest floor and observed daily was still intact after 17 days, when the first *C. viridis* arrived and was captured. When the feces was collected after 21 days, two more *C. viridis* were obtained. Several small *Aphodius* and *Onthophagus* were also collected during the same period, but no staphylinids were obtained after the eighth day. This data is consistent with the hypothesis that *C. viridis* is minimizing predation by consuming food that is no longer attractive to predatory staphylinids.

Species of dung scarabs that are competitively superior to other dung beetles and have the highest population densities are usually unable to survive for long periods of time without food (Young, ms.). In a series of laboratory starvation experiments, *C. viridis* could survive for 32 days whereas several *Aphodius* species of similar size could survive for approximately 20 days without food. Diurnal species of *Aphodius* do not perch on leaves, can be among the earliest arrivals at fresh dung, and probably reduce predation pressure by burrowing immediately into dung and creating tunnels in the soil underneath. *Canthon* species, however, may perch on leaves, can also be among the earliest arrivals at fresh dung but may be among the last, and are exposed to predation during the formation of a dung-ball and its subsequent rolling away to a burial site. Although the capability of doing without

food for long periods of time may be merely a response to low food availability, it may also allow individuals of *C. viridis* to choose the food site with the lowest possible level of potential predation.

The strategy of perching near food, before consumption is attempted, may be a technique for assessing the presence of predators. Although no direct information is available, research on dung beetles in Panama suggests that the detection of staphylinid predators may be of an olfactory nature. As discussed in Howden and Young (1981), at least one species of *Canthon* can detect the presence of another species of *Canthon* (that is competitively superior) at a food site and will not attempt to obtain food until the superior species departs. Detection of the allelochemic involved can occur at a distance of 15 cm or more. Some staphylinids are known to produce pheromones (Peschke 1978) and allelochemics (Schildknecht et al. 1976), and experimental demonstration of olfactory communication between *Canthon* species and potential staphylinid predators would not be a great surprise.

A number of criteria may need to be satisfied before a species such as *Canthon viridis* can use perching as part of a predator-assessment strategy. It should be able to detect the presence of predators, perhaps by olfactory cues, at a food site. It may employ the complementary strategy of arriving at food before and/or after potential predators arrive. It should be able to survive without food for a sufficient period to allow adequate search time for food sites without predators. And finally, perching on leaf surfaces should not increase the likelihood of predation. The first three criteria have been considered, but the final one requires some comment. *C. viridis,* like many of the leaf-sitting scarabaeines, is brightly colored (green) and shiny. This probably makes them particularly obvious to leaf-foraging visual predators such as birds and lizards. It has been suggested (Poulson 1980) that some species of *Canthon* in the tropics are distasteful to such predators and/or belong to a large mimetic complex. This has yet to be determined for *C. viridis,* in Maryland, but may function to minimize predation while sitting on leaves.

Conclusion

Given that the nature of the evidence is largely circumstantial and inferential, it still seems reasonable to suggest that a species such as *Canthon viridis,* which is so vulnerable to staphylinid predation, would have evolved a strategy for minimizing that predation. The hypothesis of predator assessment presented herein has the virtue of being testable. Although the project that produced these observations has been terminated, it is easy to envisage a series of laboratory olfactometer experiments with *C. viridis* that could demonstrate the presence or absence of staphylinid-detection capabilities. Also, manipulations in the field at dung involving removal and introduction

procedures with predators and prey could give strong support to the hypothesis. Finally, detailed field observations where diurnal forest dung beetle populations are more abundant than in Maryland could also be corroborative.

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